ACCURATE TRANSLATION

TITLE OF THE INVENTION

ELECTRONIC CAMERA FOR MICROSCOPE

BACKGROUND OF THE INVENTION

This invention relates to a microscope system including an electronic camera for electronically obtaining an image observed by a microscope.

As ~~the~~ digital technique(s) [has] love developed, [a] digital photographing has begun to be widely used in the field of a [microscope] microscopy in recent years. [The] Digital photographing [needs not to execute] does not require a developing process and thus is advantageous in easily obtaining a photograph [in comparing] as compared with [the] silver salt film photographing. [The digital] Digitally photographed data, moreover, can be stored as data in a personal computer or the like, and thus will never be deteriorated as a negative silver salt film. Further, in the case of silver salt film photography a specific space needs to be provided for storing the film.

The conventional digital photograph has not been [so good in comparing with] as good as a the silver salt film in image quality, and thus has not been used very much [not practically used in several cases]. [With developing] But with developments to improve the quality of an imaging element (CCD), the image quality of [the] digital photographing has been improved [no less than] to be equal to that of the silver salt film photograph, and thus will be widely spread in the field of [the microscope] microscopy.

An example of the electronic camera (digital

camera) used for the conventional microscope is shown in FIG. 1. Conventionally, a microscope body 1 is provided with a tri-metrogan barrel 10, and an observer 90 observes an image via a binocular eye-piece barrel 20. The tri-metrogan barrel 10 has another optical path (port) at an upper portion, and obtains a photograph image or a television monitor image using the port.

The port is fixed to an adapter 30 for a television camera, and the adapter 30 is fixed to a CCD camera 80. An electronic camera is approximate in structure to a CCD video camera used for a television monitor, and thus not the normal camera adapter but an adapter for a television camera is frequently used. The television camera adapter 30 is a barrel-shaped unit containing an optical system for relaying an image output from the tri-metrogan barrel 10 to a CCD device in the CCD camera 80 to correctly image in the CCD device.

A signal output from the CCD camera 80 is sent to a television monitor 81 through a cable, and the image can be monitored thereby. The final framing or focusing of the obtained photograph is performed while watching a monitor 81. When the CCD camera 80 is connected not to the television monitor 81 but to a personal computer 82, the image can be directly stored as a file in a personal computer 82. The CCD camera 80

connected to a personal computer 82 can be operated with use of the personal computer 82 through a key board 83. When the CCD camera 80 is connected to the monitor 81, the CCD camera 80 is operated by a handswitch 51 provided thereto. The obtained photograph is stored in a memory device in the CCD camera 80, and can be input into the personal computer by some method, or when the CCD camera 80 is connected to the personal computer, the obtained photograph is directly sent to the personal computer 82 to be stored in a memory device in the personal computer 82.

The conventional electronic camera used for the microscope has a problem that the microscope electronic camera has so many systems that a large space is occupied thereby. A microscope [has been used to] that is used for various applications [thereby] is also connected to various peripheral apparatuses, which results in [the] disorder on a desk and occupation of a large space. When the apparatuses such as the handswitch 51, the personal computer 82, and the key board 83 are further added thereto, the operability on the desk will become worse, of course. In order to obtain an image from the microscope, however, at least the television monitor 81 must be located near the microscope. In other words, if the television monitor 81 cannot be located near the microscope due to the short of the space on the desk, the framing or focusing in photographing cannot be

performed normally.

Further, the conventional microscope electronic camera is constituted of so many components, and thus has poor flexibility in terms of compatibility and mobility using it with the other microscope or in the other room. In such cases, all the components such as the television monitor 81, the personal computer 82, and the key board 83 must be carried to be used with the microscope electronic camera.

There is another problem in the electronic camera: the configuration cost of the system. The electronic photograph cannot be obtained only with use of the CCD camera 80 and the handswitch 51. A user must buy expensive apparatuses such as the television monitor 81 or the personal computer 82 only to perform the framing or the focusing.

On the other hand, in observing a specimen with use of a microscope, the microscope will be provided with various filters or optical elements suitable for the object of the observation. When the image obtained by the observation by a microscope is photographed by an electronic camera, image processings corresponding to the filter or optical element needs to be executed for the image signal or obtained by the electronic camera, in order to obtain a suitable image.

In the white balance correction example of the image processing, when a light amount of the

illumination light applied to the specimen is adjusted to observe a specimen with a light amount suitable for the observation, the white balance correction needs to be executed so as to obtain a predetermined white balance free from the color temperature change of the illumination light due to the light amount adjustment. Accordingly, [everytime when] the color temperature change of the illumination light occurs due to the insertion/extraction of the filter on the optical path of the illumination light or change the light amount of the illumination light source, the white balance is reset therefor to suitably observe the specimen.

On the other hand, there has been proposed a technique of preparing correction data for the white balance correction in initializing the microscope, as disclosed by the Japanese Patent KOKAI Application No. 6—351027, for example. According to this technique, the spectral transmission characteristics is measured on the basis of the image signal obtained by the imaging element while varying the light amount of the illumination light source and serially inserting/extracting filters used therefor, thereby the white balance correction data is prepared from all the combination of the light amounts of the illumination light source and the filters in initializing the microscope. In observing the specimen, the white balance is executed on the basis of the white balance

correction data corresponding to the light amount of the illumination light source and the condition of the filter in that time.

However, the technique of executing the white balance on the basis of the white balance correction data can be only used when the microscope is used for the transmission observation. It is difficult to prepare such white balance correction data in projection observation. Accordingly, the specimen cannot be always photographed under the suitable correction. Further, the measurement is performed through the image processing system, and thus the correction data does not always correspond to a suitable correction amount corresponding to the illumination light color temperature. Recently, there has been further proposed a microscope capable of controlling an entire microscope system such as the setting of observation method, as disclosed in the Japanese Patent KOKAI Application No. 7—199077. According to such a microscope, however, the observer must executes a plenty of processings in accordance with the observation condition such as an observation method in order to obtain a suitable image.

The object of the present invention is to provide an electronic camera for a microscope, which occupies a so small space, is constituted of components at a reasonable cost, and can obtain a digital photograph

with ease.

The other object of the present invention is to provide an electronic camera for a microscope, which can obtain an optimum image in accordance with an observation condition of the microscope and a specimen.

BRIEF SUMMARY OF THE INVENTION

The above-mentioned problems can be solved by the electronic camera for a microscope as described below.

The present invention is an electronic camera attached to a microscope, which integrally includes an imaging element, a signal processing section for processing a signal from an imaging element, a memory means for recording photographed image data, and a display means for displaying an image obtained by the imaging element.

With such a structure, in the microscope electronic camera according to the present invention, the signal from the imaging element is processed by the signal processing section, and displayed by the display means integrally provided thereto. Accordingly, by operating while watching the image of the display means, digital photographing can be attained without providing television monitor or personal computer independent therefrom.

The above-mentioned problems can be overcome by the following microscope electronic camera. More specifically, a microscope electronic camera which is

attached to a microscope having a function of the setting of the observation condition of a specimen and which attains an observation image of the specimen by an imaging element comprises:

a recognizing section which when setting of the observation condition in the microscope is changed, recognizes the information the setting of which is changed, and

a signal processing section for processing an image signal output from the imaging element in accordance with information sent from the recognizing section.

According to such a structure, the optimum image can be attained in accordance with the observation of the microscope or the specimen.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the

a screw 40A4. On the outer right side face of the casing 40A, a terminal 41 for connecting the handswitch and a slot 42 for inserting a memory card for storing the image data are provided. In the casing 40A, the CCD 43 as an imaging element and a signal processing section 44 for processing the output signal from the CCD, and the like are arranged. Reference numeral 40A5 denotes a spacer for supporting the CCD 43.

In this drawing, the LCD color monitor 45 is arranged near the eyepiece lens 31. However, the eyepiece lens 21 and the LCD color monitor 45 of the electronic camera 40 are arranged as shown in FIG. 5 in view of the easiness of the image observation and the operability of the switch and the like. The inclination angle W of the eye-piece barrel 20 is set within a scope from 20 or 30 to 45 degree. The inclination angle U of the display face is set within a scope from 5 or 10 to 25 degree (15 degree in the system of the present embodiment), as mentioned before. In a triangle formed by connecting a first [crossing] point V1 at which an optical axis 301 (axis along the line of the sight of the observer 90) of the eyepiece lens 21 crosses an axis 302 perpendicular to the display face of the LCD color monitor 45, a second [crossing] point V2 at which the display face of the LCD color monitor 45 crosses the axis 302, and [an eyepiece] a third point V3 [of] the eyepiece lens 21, when an angle X is formed

by the optical axis 301 and the axis 302, an angle Y is formed by a line 303 connecting the [eyepiece V3 of the] [eyepiece lens 21 and the crossing point V2 in the LCD] [color monitor 45 and the axis 302,] and an angle Z is formed by the optical axis 301 and the line 303, and where the inclination angle W of the eye-piece barrel 20 is set within a scope from 20 to 45 degree, and the inclination angle U of the LCD color monitor 45 is set within a scope from 5 to 25 degree, the angle X shown in FIG. 5 is set at a value within a scope from 25 to 75.

On the other hand, the angle Y, which will vary depending on the positional relationship (relationship in height or their position) between the eye-piece barrel 20 and the electronic camera 45, is set within a scope from 20 to 60 degree, for example. The angle Z is calculated from the formula $180-(X+Y)$. To sum up, the scopes of these angles are represented as follows:

angle W = 20° -45°

angle U = 5° -25°

angle X = 25° -70°

angle Y = 20° -60°

Next, the electric circuit in the electronic camera 40 will be described below with reference to FIG. 6. The electronic camera 40 has a signal processing section 44 for processing the signal output from the imaging element (CCD) 43, and a display

third point V3 and the second point V2

section 45. The processing section 44 is connected to a bus line 46, and controlled by a system controlling section 47 connected to the bus line 46. The bus line 46 is further connected to a recording medium (memory card) 49, a switch interface 48, and an external interface 50.

As shown in FIG. 6, in the signal processing section 44, a sample holding section 441 for sampling a signal output from the CCD 43 as an imaging element, an A/D conversion section 442 for performing A/D conversion, a memory controller 444 for controlling input/output of data from/to a memory 443 for temporarily storing image data, and a D/A conversion section 445 for performing D/A conversion are connected in series to output the signal output from the CCD 43 to the LCD color monitor 45.

An output signal of a timing generator 446 is input into the CCD 43 and the sample holding section 441, and an output signal of a syncgenerator 447 is input into an A/D conversion section 442, a D/A conversion section 445, and a memory controller 444. The timing generator 446, the syncgenerator 447 are connected to the bus line 46, and output a timing signal in response to an instruction output from the system controlling section 47 via the bus line 46, thereby control the operations of the blocks.

The system controlling section 47 has a CPU 471, a

ROM 473 storing an operation program, and a RAM 472 used for operations, which are connected to the bus line 46 independently. The CPU 471 executes various controls of the electronic camera 40 in accordance with operation program stored in the ROM 473.

The image data is stored/read in/from the recording medium (memory card) 49 via the bus line 46. The recording medium other than the memory card can also be used.

The switch interface 48 connects the handswitch 51 to the system controlling section 47 via the bus line 46, and sends various operation instructions such as releasing to the system controlling section 47 with use of the handswitch 51. The external interface 50 is provided to perform the data transmission from/to the external personal computer.

Next, the operation of the apparatus according to the first embodiment, which has the above-mentioned constitution, will be described below. The observation light from the specimen S illuminated by the transmission light or the projection light is collected by the objective lens 6 and incident into an optical path split prism 11 via a half mirror 8. At this time, the observation light is split into two directions. The observation light in one direction is directed to the eye-piece barrel 20, and directly observed by the observer 90 via the eyepiece lens 21. The observation light traveling in the other direction is guided to the

electronic camera 40 through the television camera adapter 30 attached to a mount on an upper portion of a tri-metrogan barrel 10.

The observation light is incident into the CCD 43 in the electronic camera 40 to be converted into an electric signal. The signal is subjected to the processings of the sample holding circuit and the A/D conversion in order, and sent to the memory controller 444, and then temporarily stored in the memory 443. In displaying the signal in the LCD color monitor 45, the image data stored in the memory 443 is read by the memory controller 444 and subjected to the D/A conversion process, and sent to the LCD color monitor 45 to be displayed therein. In photographing the image, a photographing instruction is issued to the system controlling section 47 via the switch interface 48 by handling the handswitch 51 to perform the photographing. The image data is stored in the memory 443 or the recording medium (memory card) 49.

In this manner, according to the present embodiment, the image input into the electronic camera 40 is displayed by the LCD color monitor 45 in photographing by the electronic camera. The observer 90 watches through the eye-piece barrel 20 in the normal observation, and in photographing using the electronic camera, can perform the framing or the focusing of the image to be photographed merely by looking up the display

ABSTRACT OF THE DISCLOSURE

An electronic camera provided for the microscope comprises an imaging element for imaging an optical image split by an optical path split prism, a signal processing section for processing an imaging signal output from the imaging element, a memory section for recording image data based on the imaging signal processed by the signal processing section, an LCD monitor located near the eyepiece lens, for displaying the image based on the imaging signal processed by the signal processing section, and a casing integrally containing all of the imaging element, the signal processing section, the memory section, and the LCD monitor.